Irish Academy of Engineering's Response

to

DCCAE's Consultation

on

Ireland's Draft NECP 2021-2030

February 2019

1. GHG Emissions from the Electricity Generation and Large Industries (included in the EU's Emissions Trading Scheme)

1.1 Electricity Generation

Electricity generation accounts for around two thirds of Ireland's Emissions Trading Scheme (ETS) emissions. Ireland has made great progress in the past decade in developing renewable sources of electricity, especially wind-generated. The greatest potential for reducing Ireland's GHG emissions in the electricity generation sector is clearly at the coal and peat-fired stations. Bord na Mona announced in October 2015 that it will not harvest energy peat beyond 2030 and this means that the three peat-fired stations in the Midlands (Bord na Mona's Edenderry plant and ESB's plants at Lanesborough and Shannonbridge) will close or switch to biomass before 2030. In the Academy's view, the continued operation of Moneypoint on coal is advisable until at least 2025 for several reasons. Closing the Moneypoint station at present would not actually reduce EU GHG emissions, as the emissions allowances would be taken up by power plants or industrial installations elsewhere in Europe. Moneypoint has significant advantages – primarily in terms of security of supply, as gas-fired generation would otherwise have to meet the unavoidable need for thermal generation and the issues in relation to gas supply security are addressed in a later section of this submission. In the Academy's view, closing Moneypoint in the next five years would not be in Ireland's interests. With a declining cap on emissions allowances under the ETS and higher carbon prices, it is expected that the existing units at Moneypoint must either switch to biomass or shut down before 2030 - existing Combined Cycle Gas Turbine (CCGT) plants have considerable spare generation capacity and produce approximately one third the GHG emissions of Moneypoint per unit of electricity.

Renewables will account for a growing share of Ireland's electricity supply in the next 20 to 30 years – and is projected to provide up to a half of Ireland's annual electricity by 2025. As a result of both the increased penetration of renewable generation and the development of highly efficient CCGT plants, the carbon intensity (gram CO_2/kWh) of the electricity sector in Ireland has halved between 1990 and 2015. The Academy believes that an 80% reduction in carbon intensity in the electricity sector from 1990 levels is achievable by 2030.

In the Academy's view, a combination of renewables and gas-fired generation will be the most effective way to reduce emissions in Ireland's electricity supply. Gas is a lower carbon, cost-effective back-up to the variability of wind, solar and hydropower generation. It is likely that gas-fired generation will replace coal and peat-fired generation in Ireland in the next ten years and this will increase Ireland's dependence on natural gas. Gas would then account for over 90% of Ireland's electricity generation at times of very low renewables generation. Corrib gas production is expected to cease around 2030. Ireland would then be totally dependent on Britain for our gas supply as Ireland's only gas storage facility, at the Kinsale field, is scheduled to close by 2022. But by 2030, Britain will be importing most of its gas - from Norway, Russia, Qatar and further afield. A strategic government plan is needed to diversify Ireland's gas supply and improve gas supply security.

1.2 Large Industries

Emissions elsewhere in the ETS sector – energy industries other than power generation and large manufacturing industries accounted for about one third of Ireland's ETS emissions. Significant energy efficiency gains have already been achieved in these industries. The Academy expects the downward trend in emissions from these industries to continue up to 2030, in line with trends in ETS industries elsewhere in Europe.

Overall, the Academy is confident that Ireland's GHG emissions in the ETS sector will reduce in line with EU target driven by EU-ETS strategies and especially the ETS carbon pricing mechanism.

2. The non-ETS Sectors

2.1 Transport

Transport emissions have increased in recent years as the economy recovered. The Academy examined various measures to reduce transport emissions - electric vehicles, biofuels, upgrading public transport infrastructure, changing modes of transport, taxation measures and various other options.

2.1.1 Electric Vehicles

The Academy's assessment is that Battery Electric Vehicles (BEV's) i.e. fully electric cars are unlikely to exceed 10% of the private car fleet in Ireland by 2030. This assessment is significantly below the DCCAE forecast of 20%. The Academy's assessment is based on the following

- In 2017 over 40% of the registered cars in Ireland were over ten years old, a situation that is considered likely to continue. Thus, as BEV's account for less than 1% of new car registrations at present achieving a 20% BEV penetration rate by 2030 would require that 66% of all newly registered cars were BEV's by that year, assuming a linear increase in BEV penetration.
- Ireland has a very dispersed housing pattern, with many households living in one-off houses, served by an overhead electricity network. Given the exposure of these dwellings to electricity supply disruption, due to climatic factors, sometimes for days on end and the lack of public transport in rural areas it is considered highly unlikely that any one car household in rural Ireland will commit to dependence on a BEV as their sole mode of transport. Thus, the best that can be hoped for is that one BEV may be acquired in a multi car household.
- In urban areas the bulk of housing built since 1970, which accounts for a large proportion of the total urban housing stock in Ireland, are served by an underground electricity distribution network which was designed on the basis that the 'After Diversity Maximum Demand' would be less than 3kW per house. This network limitation will present a significant barrier to achieving a high penetration of BEV's, or indeed electric central heating in those developments, in the future, unless very costly, time consuming and disruptive urban network reinforcement is undertaken.
- Worldwide car and light commercial vehicle (LCV) production was reported to be 90 million vehicles in 2015. Bloomberg New Energy Finance (BNEF) estimates that up to 30 million BEV's

could be produced in 2030, with up to half the total output in China. Thus, an assumption that up to 33% of new car sales in Ireland would be BEV's in 2030 appears consistent with global estimates and with BEV's achieving a 10% penetration of the car fleet in Ireland by that year.

Therefore, the Academy believes that the focus on promoting and indeed incentivising BEV car sales should be on encouraging longer-distance car commuters, in multi car households, to acquire a BEV for commuting use, thus seeking to maximise BEV mileage driven and CO_2 reduction, rather than BEV sales. Examples would be the commuting counties such as Meath, Kildare and Cork where the majority of households have two or more registered cars.

But the Academy also believes that the deployment of electric Light Commercial Vehicles (LCV's) should also be a focus of attention, particularly to the rapidly growing parcel delivery sector which is driven by the switch to e-commerce. It is notable from UK statistics, where e-commerce is now estimated to account for 25% of retail sales, that CO_2 emissions from LCV's were the most significant growth area in land transport emissions. Any incentive package in this area should however be tied to a commitment by operators to pool 'final mile deliveries', to avoid the wasteful and emission intensive pattern of transport movements, now seen in the urban waste collection sector.

Auto manufacturers, including VW, are also seeking to develop battery powered mini buses to deliver an Uber style multi occupancy service in urban/ suburban areas. A feature of the proposed vehicle design is that seat widths would be such that passengers would not have to touch each other, thus encouraging multi occupancy usage by strangers. A notable feature of these developments is that as much focus is being given to the information system requirements, as vehicle design.

BNEF estimate that there are at present over 385,000 battery powered electric buses in operation in the world, with 99% of them in China. Thus, while this technology has yet to be significantly developed in Europe it could become a potentially attractive option in the future, as battery costs/kWh continue to fall, with increased battery production and battery weights/kWh also fall through technological advances.

In particular, the Academy believes that the future focus should be on providing electric powered buses on the 12 core routes identified by the National Transport Authority (NTA) in Dublin. If the reduction in bus travel times forecast by the NTA on these routes is achieved the Academy estimate that these routes could deliver the increased frequency promised with a fleet less than 400 electric buses. At present Dublin Bus operates a fleet of approximately 1,000 buses. The Academy is also acutely conscious of the considerable human resources and time required to deliver each route corridor and thus believes it will be essential to focus on those routes delivering the maximum benefit initially, if significant progress is to be achieved. The Academy recognizes that the development of these bus corridors will significantly impact some homes along the proposed routes but believe that the major benefits in terms of less traffic congestion, improved transport times and lower emissions must have a higher priority.

2.1.2 Biofuels

The EU has set a target that requires that renewable sources meet 10% inland transport energy requirements in each member state by 2020, the RES-T target. Ireland is currently on track to meet

that target, albeit using the additional credits obtained from using second generation biofuels i.e. biofuels produced from sources that do not compete with food production. Ireland's RES-T ambition is very similar to that in most other member states, with the notable exception of Sweden which the European Environment Agency (EEA) in its 2018 report, credits as having achieved a RES-T level of 30.3%. The means by which this was achieved and the costs of doing so are worthy of further examination by researchers and analysts in Ireland

The Academy does not expect the percentage of bioliquids in motor fuels in Ireland to exceed 10% by 2030, given the potential conflicts with food production, but believes that the potential to maximise the use of biogas in transport needs to be fully exploited. In Stockholm, which does not have a natural gas distribution network, much of the urban bus fleet is powered by biogas produced at the city's municipal sewage treatment plants.

In Ireland's case there are significant advantages in using biogas directly rather than injecting it into the gas network or using it for electricity generation. This is because though Ireland would get full credit for biogas production, for any renewable energy target, a much higher proportion of our natural gas usage is at sites covered by the EU's emission trading scheme and as the targets set under this scheme can be met by a variety of other means it is preferable to use biogas to displace fuel use in the non-ETS sector, where meeting our emission reduction targets will be extremely difficult. Furthermore, the capital investment/kW for small biogas powered generation units is considerably higher, than for central power stations and the efficiency of generation significantly lower.

The Academy considers that an essential element of the design of the planned new regional sewage treatment plant at Clonshaugh, in North Dublin, should be to maximise biogas production, with the biogas being piped to Dublin Airport, which is nearby and is the busiest bus station in the country. There the biogas could be used to power both the airport shuttlebus service and a portion if not all of the intercity bus fleet serving the airport. The technology for maximising biogas production is both simple and low cost and has been retrofitted at the relatively new sewage treatment plants at Drogheda and Dundalk.

Given the expansion of jet fuel uplift anticipated at Dublin Airport, due to the expansion of trans-Atlantic services and the associated increase in aviation emissions, investment in biogas powered buses, filling facilities and pipelines, by the aviation industry, would in part compensate for increased aviation emissions and contribute to the industry's obligations under the UN agreement on limiting aviation emissions.

Gas Networks Ireland has highlighted the potential for producing biogas from agricultural wastes in Ireland and the positive environmental benefits that would accrue. While the Academy has lower expectations of the potential it is fully in agreement with the objective of maximising biogas production from this source. In particular, the Academy is of the view that this technology is both most suitable and most likely to be deployed by the rapidly growing and increasingly consolidated and technically sophisticated dairy sector. But the Academy considers that the optimum use of farm biogas is potentially as a transport fuel, for milk collection trucks, because both of seasonality factors and the fact that the Academy strongly advocates that electrically powered heat pumps should be used as the primary source of heating in rural areas, with back up being provided by integrating heat pumps with existing oil fired central heating systems. Given the scale of agricultural related

greenhouse gas emissions in Ireland and the requirement to minimise those emissions, particularly from the expanding dairy sector, it is considered that the major dairy processors have both the technical capacity and financial resources to promote biogas production at farm level and its use for milk transport, as well as a social obligation to do so.

2.1.3 Promotion of Multi Passenger Occupancy

The Academy has long recognised that achieving multi passenger occupancy of cars is one of the most cost-effective ways of reducing emissions, but equally recognizes that this can be difficult to achieve in practice, even for daily commuters because of differing work and family commitments. Therefore, it believes that significant incentives need to be provided to encourage it.

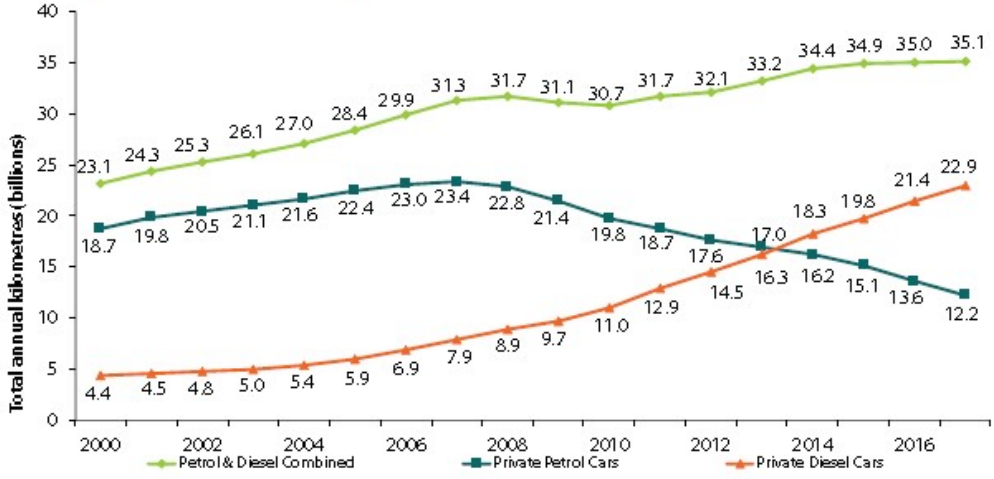
In some countries multi occupancy passenger vehicles are entitled to use special motorway or highway lanes but on the more intensely used sections of motorway in Ireland this is not technically feasible. An alternative is to make multi occupancy vehicles toll free and this could readily be trialled on the M3 and M4. If successful it could then be offered as part of a package to make multipoint tolling on the M50 and on the M7, following the upgrading of the N7 section to motorway standard.

2.1.4 Transport Fuel Taxation

Many commentators recommend raising carbon taxes, to reduce emissions. However, the evidence does not support the view that increasing carbon taxes is an effective way of reducing fuel consumption, in the absence of alternative technical solutions that deliver a similar outturn. This is clearly evident from the following figure showing SEAI's estimate of annual passenger car mileage.

Transport fuel prices increased by 42% between 2008 and 2012, primarily due to increased crude oil costs, but this had almost no impact on annual mileage, despite the fact that unemployment rates increased from 5% to 16% in the same period.

Figure 50: Total private car annual mileage 2000 – 2017



Source: Based on NCT Data

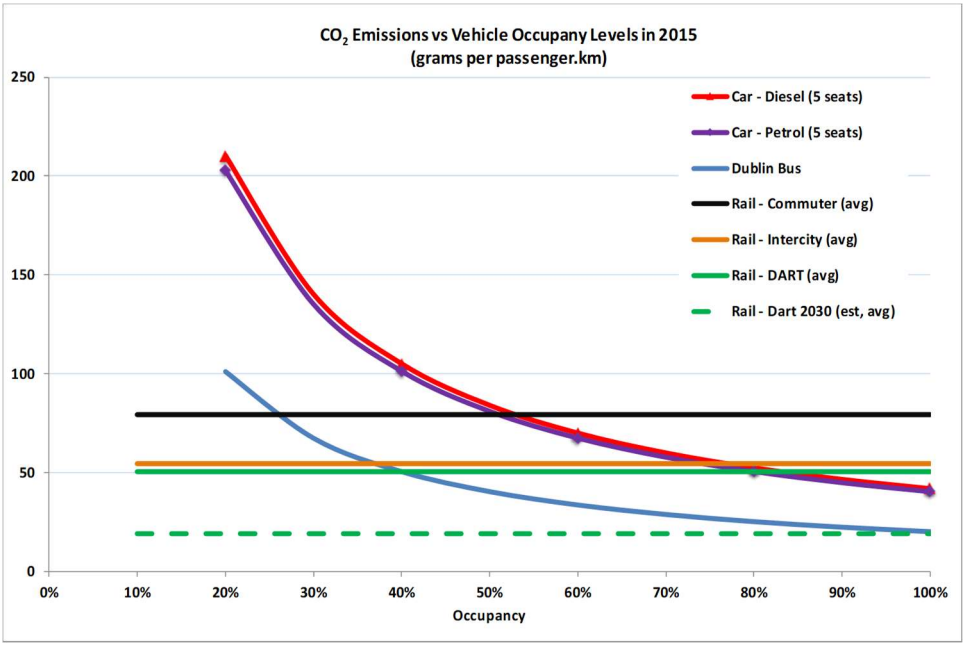
Thus, raising carbon taxes could eliminate fuel tourism but would have almost no impact on real demand. The Academy's analysis indicates that a very similar situation obtains in the residential

heating sector where demand was almost equally insensitive to a 60% increase in heating oil costs in the same period.

In contrast varying the basis for calculating VRT and road tax clearly has a very significant impact on vehicle purchasing patterns, as is clear from the above figure, provided the technical performance of the alternatives is comparable. Thus, the Academy recommends that the options in this area should be examined in detail but stresses the need for any changes to be regularly reviewed, in the event that relative (ex tax) costs of motor cars change and to prevent gaming of the system, as clearly occurred with the switch to a CO_2 based tax system.

2.1.5 Incentivize changes in mode of travel

The first and most important step in reducing transport GHGs is to reduce usage and increase efficiencies – through fewer journeys, driving less mileage, carpooling and ride-sharing and using more fuel-efficient vehicles. More sustainable modes of transport like walking, cycling and more use of public transport need to be promoted and facilitated by further investment. The Academy's analysis shows that the relative CO_2 emissions per passenger per km depend on actual occupancy levels in whatever mode of transport is used, as shown below.



Thus, a car with high occupancy levels is equally or more efficient in terms of CO_2 emissions per passenger km than a bus or train with average or low occupancy levels. Government policies and transport strategies should therefore be geared to encouraging the most efficient transport mode, including ride-sharing.

Consideration should also be given to the introduction of levies on all off-street commuter car-parking spaces in central Dublin, the majority of which are currently free of charge.

2.1.6 Investment in transport infrastructure and public transport systems

The Academy in its April 2016 report Sustainable Transport Infrastructure 2035 estimated that an investment of €2 billion p.a. will be needed for the next 15 years on transport infrastructure and

transport systems to provide the basic infrastructure necessary to meet the needs of Ireland's growing economy. Over €1 billion will need to be spent each year on new transport projects; a similar amount will need to be spent on maintenance. This would mean a capital expenditure of approximately €15 billion on new transport infrastructure between now and 2030; of this €9.25 billion relates to urban infrastructure. While this investment is primarily designed to provide the required level of mobility it has the additional benefit of reducing transport related emissions and congestion, if directed to sustainable transport solutions, as advocated by the Academy. Thus, the Academy considers that one third of the proposed investment in public transport should be deemed as necessary to meet national emission targets.

This expenditure, though obviously very considerable, needs to be considered in the context of over €5 billion Government income each year in motor-related taxes. An annual investment of €2 billion would be in line with most OECD countries where typically 0.9% of GDP is spent on inland transport infrastructure. While this investment is primarily designed to provide the required level of mobility with minimal congestion, it has potentially the additional benefit of significantly reducing transport related emissions, if directed to sustainable transport solutions, as advocated by the Academy. Consideration should also be given to greater subsidies to make use of public transport more attractive. Ireland ranks as one of the highest in the EU (after the UK) in terms of public transport fare/subsidy ratio.

2.1.7 Establish a state agency to develop strategies and polices to reduce transport emissions

Given the magnitude of the challenges in reducing emissions in transport, the Academy believes that a well-resourced organization needs to be established by the Irish Government with the capacity to develop strategies, polices and action plans to enable Ireland transition to a low-carbon transport future. Currently, several Government departments are involved in policy-making and implementation in the transport sector (DCCAE, Transport, Finance/DPER, NTA, TII, CIE Group Companies). A single organization with the resources and capacity to develop effective strategies is advisable.

3. Residential Sector

The key measures to further reduce GHG emissions in the Residential Sector are:

- Upgrade existing homes and reduce energy consumption through better insulation.
- Use energy sources which are more efficient in terms of GHG emissions.
- Build all new homes to Near Zero Energy Building (NZEB) standards.

The potential of these measures is assessed further below.

3.1 Home Insulation Upgrades

Grant-aided retrofit upgrading programmes (through the *Home Energy Savings* and *Warmer Homes Schemes*) have achieved the upgrading of over 300,000 units in the 10 years up to end 2015 – about 17.5% of total occupied housing stock. Most of these upgrades have been shallow retrofits.

The insulation industry estimates that a similar number of houses completed insulation upgrades without accessing SEAI's grant package. Thus, approximately 600,000 dwellings have received

insulation upgrades i.e. approximately one third of the 1.9 million dwellings whose insulation is below current standards.

Upgrading 1.3 million homes between now and 2030, at an average cost of €5,000 per home for shallow retrofit, would cost €6.5 billion and reduce GHG emissions by approximately 1.0 million tonnes CO_2, on the basis of a 20% energy saving. This will require a far more aggressive programme of retrofitting– targeting 100,000 homes per year, more state investment and better financing schemes.

Achieving a higher level of savings requires deep retrofitting at a cost of €20,000-30,000/house. But because of the intrusive nature of the work involved this is generally undertaken on change of ownership. Thus, a target of 20,000 units/year would appear a more realistic target for deep retrofitting, at a total cost of about €7.5 billion. Energy savings of approximately 50% can be achieved through deep retrofitting, resulting in savings of a further 0.8 million tonnes CO_2 p.a. Thus, through an extensive programme of home insulation it would appear feasible to reduce residential CO_2 emissions by 1.8 million tonnes.

3.2 Switch from Oil-Fired to Gas-Fired Central Heating in Urban Areas

Oil usage for central heating in Ireland is close to twice that of natural gas, which is in sharp contrast to other EU countries where average gas usage in the residential sector is 2.7 times higher than oil use. Natural gas burns more cleanly than other hydrocarbons, producing up to 30% less CO_2 than oil and about 45% less than coal. However, the CO_2 emissions from solid fuel heating systems, for the same effective heat output are much higher, when appliance efficiencies are considered.

There are almost 300,000 households in urban areas in Ireland which use oil-fired central heating and 100,000 of these are located within 20 metres of gas supply. The cost of extending gas supplies to households in 'Non-Gas' urban estates located near the gas network was estimated by BGE in 2012 to be €1,750/house on average. Thus, the overall capital cost of converting oil fired households to gas heating is estimated at an average of €5,000/household, including boiler replacement where appropriate. A total investment of €1.5 billion would be required.

3.3 Retrofit Heat Pumps in Rural Dwellings

There are 400,000 dwellings in rural areas (remote from the natural gas grid) with oil-fired central heating. Installing heat pumps in the 300,000 permanently occupied houses, operating in conjunction with existing oil-fired central heating, would reduce oil use in those dwellings by approximately 90%. Ireland now has a very large surplus of highly efficient natural gas-fired CCGT plant the additional electricity required can be delivered at 50% efficiency in primary energy terms. Furthermore, the recently-upgraded rural electricity network has sufficient electrical capacity for widespread installation of heat pumps.

Heat pumps take low temperature heat from the air, ground or water and use that heat to produce higher temperature water, for the central heating system. Retrofitted heat pumps in Irish climatic conditions will have a Seasonal Coefficient of Performance of three or more i.e. the heat pump will produce three times the amount of heat output as the electricity input to drive the system. The difference between the electricity input and effective heat output is classed as renewable energy, being recovered from air, ground or water.

Heat pump technology has matured significantly in terms of performance and reliability, in the past few years. Heat pumps have long been successfully deployed in other EU countries.

Consideration should also be given to classifying heat pumps as regulatory assets. Air-sourced heat pumps are most cost-effective in retrofit situations, costing an estimated €6,000 per house, assuming a very large-scale programme with the consequent economies of scale. Heat pump installation in ca 300,000 houses would cost €1.8 billion over the next 15 years. Installation and maintenance of heat pumps would also provide significant employment opportunities for highly-skilled technicians in rural Ireland.

But in addition to reducing CO_2 emissions heat pumps have the additional advantage of contributing to renewable energy targets. Based on the EU's assessment methodology installing 300,000 heat pumps, rated at 16kW heat output, would earn a renewable energy credit of 11.794 MWh/unit, equivalent to 1350MW of wind generation, which would have required a capital investment of €3.0 billion, inclusive of network reinforcement investment.

3.4 Upgrade to Smart Electrical Thermal Storage

Innovation in Smart Electric Thermal Storage (SETS) heating has the potential to revolutionise domestic heating in the 140,000 dwellings (many of which are apartments) currently relying on electrical storage heating. These innovative storage heating units have much more controllable heat storage capacity (25kWh), with "intelligent" electricity intake and heat output.

If SETS are installed in 140,000 dwellings, each with a load of 4-6kW, these would give potential to instantaneously control 560-840MW of grid demand. Smart meter control of heat pumps and electrical storage heating would give additional benefits.

There are around 150,000 households in Ireland using coal, petcoke or peat for central heating. These households use an estimated 3.25 toe/household and thus emit approximately 2 million tonnes of CO_2 per annum. Installing two SETS units/household has the potential to reduce their solid fuel use by approximately one third, assuming the solid fuel is being used at 50% efficiency, thus reducing CO_2 emissions by 0.65 million tonnes. The capital cost would be approximately €1500 per household or €220 million in total, giving a capital investment requirement of €340 per tonne of CO_2 abated per annum.

3.5 New homes

It is generally recognized that Ireland will need around 25,000 new homes each year to meet demographic demand. There will be a huge opportunity to build in new energy efficient homes in the right places if the right planning and investment decisions are made. The current Building Regulations (Part L, 2011), if enforced, will result in a step-change improvement in the energy performance of new homes. With these standards, oil or gas-fired heating would not be required and electric (around 2kW for a typical house would be sufficient) should become the norm.

However, the EU Regulation that requires energy use/sq.m to be reported in primary energy terms, while fundamentally logical, militates against the use of advanced electrical heating systems in Ireland because of the utilisation by regulatory agencies of historic generation efficiency data, until recently and even now the use of slightly forward projections. Given the very long life of housing

assets, the barriers to changing heating systems and the ultimate requirement to phase out fossil fuel fired heating systems it is essential that generation efficiency numbers which reflect fully anticipated developments, in the electricity sector, are used in computing primary energy use for regulatory purposes.

Thus, the Academy recommends the adoption of a figure of 65% for generation efficiency as it reflects the Academy's assessment of the likely outturn in 2030.

Increasing urban housing density and reducing the proportion of one-off rural houses would contribute to a reduction in transport emissions and foster increased public transport usage.

From the above it can be concluded that there is the potential to reduce CO_2 emissions in the residential sector by up to 4 million tonnes p.a. as summarized below:

4. Agriculture

Agriculture is by far the largest sector, outside of the ETS, accounting for around a third of Ireland's total GHG emissions and almost half of non-ETS emissions. Detailed assessments and research have been undertaken by Teagasc to identify the most cost-effective ways of reducing emissions in the agriculture sector. It has identified how GHG emission reductions of up to 2.5 mt p.a. could be achieved, at a cost of less than €30/t abated, which is substantially less than in many other sectors of the economy. Thus, the focus must be firmly on achieving these savings.

5. Overall Feasibility and Costs of 2030 Targets

The Academy's conclusion is that the 2030 targets are just about feasible but will require huge investment. The measures identified in this report would require an investment of approximately €35 billion by 2030. The cost of reducing emissions in certain sectors has not been estimated, due to a lack of data and therefore the total cost is likely to be significantly more than €35 billion.

The approach taken in the Academy's analysis is to exceed the 43% target in the ETS sector (which the Academy believes is feasible) and use these spare allowances in the non-ETS sector where GHG reductions are much more difficult to identify. Alternative approaches also need to be considered.

Detailed analysis of the costs, their impact on Ireland's competitiveness and the socio-economic implications of reducing emissions in all sectors, including agriculture, need to be carried out. Decisions can then be taken on the most effective strategies to achieve the 2030 targets. The Academy hopes that this report will trigger more debate and detailed assessments of the best options to reduce Ireland's GHG emissions within the various sectors. Then decisions can be taken on emissions reduction strategies which best serve the national interest.

Attachments

Irish Academy of Engineering Reports

1. Ireland's 2030 Greenhouse Gas Emissions Target: An Assessment of Feasibility and Costs (November 2016)
2. Natural Gas – Essential for Ireland's Future Energy Security (July 2018)
3. Sustainable Transport Infrastructure 2035 (April 2016)